

Contribution Of Audio, Visual, And Audio-Visual Instructional Materials to Learning of Numeracy Skills Among Pre-Primary Children, In Kilosa District- Morogoro Region, Tanzania.

RICHARD MICHAEL CHILIGATI¹, PROF. AKUNDAELI S MBISE ²

^{1, 2}*School of Education (SoED) University of Dar es Salaam, Dar es Salaam, Tanzania.*

Abstract- Early numeracy skills are fundamental for children's future academic achievement and cognitive development. In pre-primary education, instructional materials play a significant role in helping children understand mathematical concepts through concrete, interactive, and sensory learning experiences. This paper examined the contribution of audio, visual, and audio-visual instructional materials to learning numeracy skills among pre-primary children in Kilosa District-Morogoro Region, Tanzania. The paper specifically explored how these instructional materials support counting, number recognition, problem-solving, children engagement, and conceptual understanding. Guided by Sociocultural Theory, the study adopted a qualitative approach through review of empirical literature and classroom-based evidence from global, African, East African, and Tanzanian contexts. Findings indicate that audio instructional materials such as songs, rhymes, and storytelling improve counting fluency, listening skills, and memory retention. Visual instructional materials including flashcards, charts, puzzles, manipulatives, and real objects enhance number recognition, conceptual understanding, and problem-solving abilities. Audio-visual instructional materials such as animated videos, educational television, and digital games significantly increase learner engagement, participation, and retention of mathematical concepts. Recent studies show that animated arithmetic media and interactive multimedia technologies positively influence preschool children's early numeracy achievement. Despite these benefits, challenges such as inadequate resources, overcrowded classrooms, insufficient teacher training, and limited technological infrastructure continue to hinder effective utilization of instructional materials. The paper concludes that effective integration of audio, visual, and audio-visual instructional materials strengthens early numeracy development and promotes learner-centered teaching in pre-primary classrooms.

Keywords: Audio Materials, Visual Materials, Audio-Visual Materials, Instructional Materials, Early Numeracy, Pre-Primary Education, Numeracy Skills.

I. INTRODUCTION

Early childhood education is widely recognized as a critical stage in children's cognitive, emotional, social, and academic development. During pre-primary education, children develop foundational skills that influence future learning and educational achievement.

Among these competencies, numeracy skills are particularly important because they enable children to understand numbers, counting, measurement, patterns, comparison, sequencing, and problem-solving processes necessary for everyday life and future mathematics learning.

Early numeracy refers to children's understanding of mathematical concepts before formal schooling. These skills include counting, number recognition, sorting, matching, sequencing, classification, spatial awareness, and quantity comparison (Daryati, 2025).

Research has shown that children who acquire strong early numeracy skills are more likely to succeed academically in mathematics and related subjects in later educational stages (Saija et al., 2024).

Young children learn best through active participation, sensory experiences, play, and interaction with their environment (Daryati, 2025). Therefore, instructional materials are essential in helping teachers transform abstract mathematical concepts into concrete and meaningful learning

experiences. Audio, visual, and audio-visual instructional materials support learner participation, creativity, attention, motivation, and conceptual understanding (Nurlaila & Rocmah, 2024).

Audio instructional materials include songs, rhymes, storytelling, recorded lessons, and oral counting activities. Visual instructional materials involve flashcards, charts, puzzles, manipulatives, pictures, and real objects.

Audio-visual instructional materials combine sound and visual elements through videos, animations, educational television, multimedia technologies, and digital games.

Recent studies indicate that digital and animated instructional media significantly improve preschool children's counting skills, number recognition, and mathematical understanding (Saija et al., 2024; Nurlaila & Rocmah, 2024).

Despite their importance, many pre-primary schools, particularly in developing countries, continue to experience shortages of instructional resources, inadequate technological infrastructure, overcrowded classrooms, and insufficient teacher competence in integrating instructional materials into classroom teaching.

This paper therefore examined the contribution of audio, visual, and audio-visual instructional materials to learning numeracy skills among pre-primary children.

1.1 Statement of the Problem

Although early numeracy skills are essential for children's academic success, many pre-primary children continue to demonstrate poor mathematical competencies during transition to primary education. Several studies associate this problem with inadequate instructional materials and ineffective teaching approaches.

In many pre-primary classrooms, numeracy instruction remains teacher-centered and largely dependent on verbal explanations and rote memorization with limited use of interactive and child-centered instructional materials. Consequently,

children fail to develop conceptual understanding and positive attitudes toward mathematics.

Research has established that audio, visual, and audio-visual instructional materials significantly improve children's numeracy learning when effectively integrated into classroom instruction.

Studies on animated arithmetic media and interactive learning technologies reveal positive effects on counting abilities, digit recognition, and learner participation (Daryati, 2025; Nurlaila & Rocmah, 2024).

However, limited studies have comprehensively examined how different categories of instructional materials specifically contribute to numeracy skills development in pre-primary classrooms, particularly within Tanzanian educational contexts. This study therefore sought to address this gap.

1.2 Objectives of the Study

The study was guided by the following objectives:

1. To examine the types of audio, visual, and audio-visual instructional materials used in pre-primary numeracy classrooms.
2. To explore how audio, visual, and audio-visual materials enhance children's engagement and participation in numeracy learning among pre-primary children
3. To explore challenges affecting the utilization of instructional materials in pre-primary education.

1.3 Research Questions

1. What types of audios, visual, and audio-visual instructional materials are used in pre-primary classrooms?
2. How audio, visual, and audio-visual materials enhance children's engagement and participation in numeracy learning among pre-primary children?
3. What challenges affect the use of instructional materials in pre-primary education?

II. LITERATURE REVIEW

2.1 Theoretical Framework

This study was guided by Sociocultural Theory developed by Lev Vygotsky (1978). The theory

explains that children's learning and cognitive development occur through social interaction, communication, and participation in culturally meaningful activities.

According to Vygotsky, instructional materials are important cultural tools that mediate learning experiences and support cognitive development.

The theory emphasizes the Zone of Proximal Development (ZPD), which refers to the difference between what children can achieve independently and what they can accomplish with guidance and support from teachers or peers.

In numeracy instruction, audio, visual, and audio-visual materials help teachers scaffold children's understanding of mathematical concepts through guided interaction.

For example, songs, number charts, animated videos, counting sticks, and puzzles support counting, number recognition, and problem-solving skills by providing meaningful and interactive learning experiences. The theory also emphasizes language, communication, and culturally relevant learning materials in promoting conceptual understanding.

The theory was considered appropriate for this study because it explains how instructional materials contribute to numeracy learning through interaction, scaffolding, guided participation, and learner engagement.

2.2 Empirical Literature Review

2.2.1 Global Perspectives

Globally, studies in early childhood education demonstrate that instructional materials significantly improve children's numeracy skills development.

Nurlaila and Rocmah (2024) conducted a study in Indonesia on the use of animated arithmetic media among children aged 5–6 years. The study found that animated audio-visual instructional materials significantly improved counting abilities and number recognition among pre-primary children.

Similarly, Saija et al. (2024) investigated the effects of numerical video training among preschool children at risk of numeracy difficulties. Findings revealed

that educational videos enhanced children's early numeracy skills, particularly counting and digit recognition. Dore et al. (2023) further established that digital picture books containing visual and auditory enhancements improved comprehension and learning among young children.

Research by Daryati (2025) also found that interactive multimedia instructional materials significantly improved pre-primary children's counting skills compared to traditional teaching methods. These studies demonstrate that audio, visual, and audio-visual materials enhance learner participation, conceptual understanding, and mathematical achievement in early childhood education.

2.2.2 African Perspectives

In Africa, research on instructional materials and numeracy learning has increasingly focused on learner-centered teaching and resource availability.

A study conducted in Kenya by Shikuku and Mwangi (2023) examined the frequency of use of instructional media in acquisition of numeracy skills among pre-primary children in Nairobi County.

Findings revealed that instructional materials such as sticks, stones, bottle tops, blocks, and containers improved children's numeracy learning. However, limited frequency of instructional media usage affected effective numeracy acquisition.

Studies across African countries further reveal that manipulative and visual instructional materials improve counting skills, learner participation, and conceptual understanding. However, inadequate teaching resources, overcrowded classrooms, and insufficient teacher preparation remain major challenges affecting effective implementation of learner-centered pedagogy.

2.2.3 East African Perspectives

In East Africa, studies emphasize the importance of interactive and culturally relevant instructional materials in promoting early numeracy learning.

Research conducted in Kenya and Uganda shows that visual and manipulative instructional materials improve children's counting, classification,

sequencing, and matching abilities. Studies also indicate that songs, rhymes, and storytelling activities improve children's memory retention and mathematical vocabulary development.

Additionally, recent educational reforms in East Africa encourage integration of digital learning technologies and play-based instructional approaches in pre-primary education to improve learner engagement and mathematical understanding.

2.2.4 Tanzanian Perspectives

In Tanzania, studies on early childhood education indicate that instructional materials significantly influence children's learning outcomes.

Ndijuye and Dadi (2023) found that supportive learning environments and instructional resources positively influenced children's early mathematics skills during transition from pre-primary to primary education.

Sobayi (2017) also established that inadequate instructional materials and poor learning environments negatively affected children's early numeracy development in Tanzanian pre-primary schools.

Studies in Tanzania further reveal that teachers often experience difficulties in improvising instructional materials and integrating audio-visual technologies into classroom teaching due to limited training and inadequate resources.

2.3: Research Gap

Previous studies conducted globally and across Africa have established that instructional materials contribute significantly to early numeracy skills development among pre-primary children.

Research by Nurlaila and Rocmah (2024), Saija et al. (2024), and Shikuku and Mwangi (2023) revealed that audio, visual, and audio-visual instructional materials improve counting abilities, number recognition, conceptual understanding, learner participation, and motivation during numeracy learning.

However, many of these studies focused mainly on digital technologies, instructional media utilization,

or general mathematics achievement without specifically examining the combined contribution of audio, visual, and audio-visual instructional materials to different numeracy competencies among pre-primary children.

Furthermore, limited studies explored teachers' classroom experiences and children's interaction with instructional materials during numeracy instruction.

In Tanzania, existing studies mainly examined learning environments, parental involvement, teacher competence, and general instructional resource availability in early childhood education.

Although studies by Sobayi (2017) and Ndijuye and Dadi (2023) acknowledged the importance of instructional materials in promoting early mathematics learning, they did not comprehensively examine how audio, visual, and audio-visual instructional materials specifically contribute to numeracy skills development in pre-primary classrooms.

In addition, few studies used qualitative approaches to capture teachers' and head teachers' perspectives regarding classroom practices, learner engagement, and challenges affecting effective utilization of instructional materials. Therefore, this study sought to fill this gap by examining the contribution of audio, visual, and audio-visual instructional materials to learning numeracy skills among pre-primary children.

III. METHODOLOGY

3.1 Research Approach

The study employed a qualitative research approach to gain an in-depth understanding of how numeracy instructional materials contribute to early numeracy skills development in pre-primary classrooms. The approach enabled the researcher to explore teachers' and head teachers' experiences, perceptions, and classroom practices in their natural settings.

Qualitative research was considered appropriate because it provides detailed descriptive information about teaching and learning processes. It also allowed participants to express their views freely regarding

the use and challenges of instructional materials in numeracy instruction.

3.2 Research Design

The study used a multiple case study design to investigate numeracy instructional practices in selected public pre-primary schools in Kilosa District. Each school represented a separate case through which detailed information was collected and analyzed.

The design enabled comparison of experiences and practices across different schools and classrooms. Furthermore, it allowed the researcher to obtain rich and contextualized data concerning the use of instructional materials in numeracy teaching.

3.3 Study Area

The study was conducted in public pre-primary schools in Kilosa District, Morogoro Region, Tanzania. Kilosa District was selected because it reflects common challenges facing public early childhood education, including inadequate instructional materials and overcrowded classrooms.

The district also has a mixture of rural and semi-urban schools, making it suitable for understanding diverse teaching contexts. The area therefore provided relevant information on the contribution of instructional materials to numeracy skills development.

3.4 Participants

The study involved a total of twenty participants, including ten pre-primary teachers and ten head teachers from selected public schools in Kilosa District. Teachers were included because they are directly involved in classroom numeracy instruction and daily use of instructional materials.

Head teachers participated because they supervise teaching activities and oversee the provision of learning resources in schools. Participants were purposively selected based on their experience and involvement in pre-primary education.

3.5 Data Collection Methods

The study used interviews, classroom observations, and documentary review to collect data. Semi-

structured interviews enabled participants to share their experiences and opinions regarding numeracy instructional materials.

Classroom observations helped the researcher examine actual teaching practices and learner interaction with instructional materials. Documentary review involved analyzing lesson plans, schemes of work, and curriculum documents to determine how instructional materials were integrated into numeracy teaching.

3.6 Data Analysis

Data collected from interviews, observations, and document reviews were analyzed using thematic analysis. The researcher carefully read and organized the data to identify common ideas and patterns related to the study objectives.

Similar responses were grouped into themes such as types of instructional materials, learner engagement, and challenges affecting material usage. The findings were then interpreted and presented narratively using direct quotations and observational evidence from the field.

IV. FINDINGS OF THE STUDY

The findings of the study are presented according to the study objectives and are supported by evidence obtained from interviews, classroom observations, and documentary reviews. The study revealed that audio, visual, and audio-visual instructional materials significantly contributed to the development of numeracy skills among pre-primary children.

The instructional materials improved counting abilities, number recognition, conceptual understanding, learner participation, memory retention, concentration, and problem-solving skills. However, several challenges affecting the effective utilization of instructional materials in pre-primary classrooms were also identified.

4.1 Audio Instructional Materials and Numeracy Skills Development

The findings revealed that teachers used various audio instructional materials such as songs, rhymes,

storytelling, counting chants, oral questioning, and recorded audio clips to support numeracy learning.

Teachers explained that audio instructional materials enhanced children's counting fluency, pronunciation of number names, listening skills, vocabulary development, and memory retention. Classroom observations further showed that children became highly engaged during counting songs and rhythmic activities.

One teacher explained:

"Whenever I want to teach specific numeracy skills using audio materials like counting from one to nine, I record the lesson using a mobile phone and preserve it for presentation. During classroom sessions, children listen and imitate the rhymes, which help them pronounce number names correctly." (Pre-primary School Teacher G, School 7)

Another teacher stated:

"Children enjoy learning numbers through songs because they remember quickly when they sing repeatedly. Even children who fear mathematics become active during counting songs" (Pre-primary School Teacher 2, School B).

The findings further showed that repeated listening and participation in songs and rhymes improved children's confidence and participation during numeracy lessons. Head teachers also acknowledged that audio activities improved learner concentration because young children enjoy music and repetition.

Despite these benefits, teachers reported several challenges affecting the use of audio instructional materials. These included poor audibility of recorded clips, lack of recording devices, limited technical skills, and difficulties teaching abstract mathematical concepts through sound alone.

In addition, children with hearing impairments experienced difficulties benefiting from audio-based instruction.

Overall, the findings indicate that audio instructional materials contribute significantly to the development of counting skills, listening abilities, learner

participation, and memory retention among pre-primary children.

4.2 Visual Instructional Materials and Numeracy Skills Development

The study established that visual instructional materials were the most commonly used resources in pre-primary numeracy classrooms. Teachers frequently used number charts, flashcards, bottle tops, counting sticks, beads, puzzles, diagrams, pictures, stones, seeds, and other real objects during instruction.

The findings revealed that visual instructional materials made mathematical concepts more concrete and meaningful because children were able to see, touch, arrange, and manipulate objects while learning.

One teacher explained:

"Using visual teaching and learning materials increases children's participation and makes lessons more real and active." (Pre-primary School Teacher F, School 6)

Another teacher stated:

"Whenever I use visual materials like charts or real objects, children count aloud while identifying numbers. This helps them understand the names and shapes of numbers through both symbols and words." (Pre-primary School Teacher C, School 3)

Classroom observations showed that children became highly engaged during activities involving counting objects, puzzles, and classification exercises. Children demonstrated curiosity and enthusiasm while arranging objects according to quantity, size, and shape.

Teachers also explained that visual instructional materials improved number recognition, conceptual understanding, counting abilities, problem-solving skills, and memory retention.

The findings further revealed that many teachers improvised instructional materials using locally available resources such as bottle tops, sticks, stones, cartons, and seeds due to shortages of commercial teaching aids.

However, children with visual impairments experienced difficulties interacting with displayed materials and often depended on verbal explanations from teachers and peers. Overall, the findings indicate that visual instructional materials significantly strengthen conceptual understanding, active participation, number recognition, and counting skills among pre-primary children.

4.3 Audio-Visual Instructional Materials and Numeracy Skills Development

The study found that audio-visual instructional materials such as animated videos, educational television programs, projectors, mobile phones, and recorded video clips positively influenced learner engagement, concentration, participation, and understanding of mathematical concepts.

Teachers and head teachers explained that audio-visual materials enhanced learning because children could simultaneously see demonstrations and hear explanations during instruction.

One Head teacher explained:

“Audio-visual materials help teachers overcome challenges in teaching difficult numeracy concepts because children can see and hear at the same time.” (Pre-primary School Head Teacher I, School 9).

Another teacher stated:

“Children pay more attention when we use videos because they see and hear at the same time. They enjoy learning through animations and quickly understand counting activities.” (Teacher 2, School A).

Classroom observations further revealed that pre-primary children remained attentive and actively participated during lessons involving digital learning activities. Some teachers used downloaded video clips to teach counting numbers, object-number relationships, and the concept of zero. Children repeated numbers enthusiastically after animated demonstrations and actively participated in counting games.

The findings also showed that audio-visual instructional materials supported children with special educational needs because recorded lessons

could be replayed repeatedly for reinforcement and revision purposes.

Despite these benefits, respondents identified several challenges affecting effective utilization of audio-visual instructional materials. Many schools lacked televisions, projectors, computers, electricity, and internet connectivity. Teachers also reported insufficient training in educational technology integration.

Overall, the findings suggest that audio-visual instructional materials significantly improve learner engagement, concentration, participation, and understanding of mathematical concepts. However, inadequate technological infrastructure and limited teacher competence hinder their effective implementation in many pre-primary schools.

4.4 Pre-primary Children Engagement and Participation

The study revealed that instructional materials significantly enhanced children engagement, participation, confidence, and motivation during numeracy lessons. Teachers explained that children became more active and interested when lessons involved songs, games, manipulative activities, counting objects, and visual demonstrations.

One teacher stated:

“Children participate more when they are allowed to play, count objects, and sing during lessons. Even shy children become active” (Teacher 9, School H)

Another teacher explained:

“Instructional materials make learning enjoyable because children interact with real objects and activities instead of only listening to explanations.” (Teacher 10, School I).

Classroom observations further showed that children paid greater attention and participated more actively during practical activities compared to lessons dominated by verbal explanations. Children demonstrated enthusiasm, cooperation, and confidence while interacting with instructional materials during numeracy tasks.

These findings demonstrate that instructional materials promote child-centered learning by encouraging active participation, interaction, creativity, and learner motivation in numeracy classrooms.

4.5 Challenges Affecting Utilization of Instructional Materials

The study identified several challenges affecting effective utilization of instructional materials in numeracy learning. The major challenges included inadequate teaching resources, overcrowded classrooms, insufficient teacher training, limited technological infrastructure, unreliable electricity supply, and inadequate funding.

One teacher complained:

“We have many pre-primary children but very few teaching materials. Sometimes children share one chart or counting aid, which reduces participation” (Teacher 2, School A)

Another teacher added:

“Overcrowded classrooms make it difficult to conduct practical activities because not every child receives enough attention.” (Teacher 5, School B)

Respondents further explained that many schools lacked sufficient technological devices to support audio-visual instruction, while some teachers had never received professional training on the use of educational technologies in early childhood classrooms.

Overall, the findings indicate that although instructional materials contribute significantly to numeracy learning, systemic and resource-related challenges continue to hinder their effective utilization in pre-primary classrooms.

V. DISCUSSION OF FINDINGS

The findings indicate that audio, visual, and audio-visual instructional materials significantly contribute to early numeracy skills development among pre-primary children. These findings support Sociocultural Theory, which emphasizes learning through interaction, tools, and guided participation.

The study showed that the majority of the schools did not have all of the prescribed types of materials suitable for pre-primary school children’s learning. These materials included audio and audio-visual materials. The majority of teachers used visual materials mostly rather than combined audio and audio-visual materials.

The choice of visual teaching materials was based on teachers’ competence and availability. Syofyan and Siwi (2018) stressed that visual materials tend to be plentiful, easy to prepare, simple to use, and require short instruction time.

Olube (2015) further argued that visual materials assist teachers in clarifying and simplifying the teaching and learning of numeracy skills by making them more actual, active, motivating, and encouraging.

Morgado et al. (2020), on the other hand, tackled the issue of some children’s inability to read and count the numbers presented due to the small size of the objects.

Teaching in such classes was likely to be abstract rather than objective and practical. This contradicts the assertion by Wynn (1992) that children below the age of six learn best when they have objects (materials) they can manipulate. Such instruction may not be able to make the lesson enjoyable, thus capturing children’s attention and making them as active as advocated by Montessori (1949).

Regarding the use of audio materials in the teaching of numeracy skills, the study by Wynn (1992) established that some teachers were willing to use audio materials in teaching. However, they. However, they lacked audio tape materials for capturing and storing clips.

This is in line with a study by Morgado et al. (2020), who observed that pre-primary school teachers have the inspiration to use audio clips like music, rhyme songs of numbers, recorded tapes, or poems for children to listen to and learn, but they lack supportive devices.

Syofyan and Siwi (2018) argued that when teachers lack expertise in using audio teaching materials in numeracy learning, children's mastery of expected skills becomes difficult. Furthermore, Usmiyatun et al. (2023) argued that the lack of integration of all sense organs during learning makes audio materials unfriendly for children's numeracy skills.

Audio instructional materials improved counting fluency, listening abilities, and memory retention through repetition and rhythmic learning activities. Visual instructional materials transformed abstract mathematical concepts into concrete learning experiences, enhancing conceptual understanding and problem-solving skills.

Audio-visual instructional materials were particularly effective in promoting learner engagement, participation, attention, and retention of mathematical concepts. These findings are consistent with studies by Saija et al. (2024) and Nurlaila and Rocmah (2024), which established that animated and digital instructional media improve preschool children's numeracy learning outcomes.

However, inadequate resources, overcrowded classrooms, and insufficient teacher training continue to affect effective implementation of learner-centered instructional practices in many schools.

VI. CONCLUSION

The study concludes that audio, visual, and audio-visual instructional materials contribute significantly to learning numeracy skills among pre-primary children. Audio materials improve counting fluency, listening skills, and memory retention through songs, rhymes, and oral activities.

Visual instructional materials enhance number recognition, conceptual understanding, and problem-solving abilities through concrete and attractive learning experiences. Audio-visual materials increase learner attention, engagement, participation, and retention of mathematical concepts through interactive multimedia experiences.

The study further concludes that effective instructional materials should be age-appropriate,

interactive, culturally relevant, attractive, and safe for children. Despite their importance, challenges such as inadequate resources, overcrowded classrooms, and limited teacher training continue to affect effective utilization of instructional materials.

Therefore, governments, schools, and educational stakeholders should invest in instructional resources, teacher professional development, and technological infrastructure to strengthen early numeracy education in pre-primary classrooms.

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